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Staff Paper

Prepared by the

Industry, Technology, and Employment Program

Office of Technology Assessment

July 24, 1985

Response to Request from Congressman LaFalce for Review of Documents on the Cleanup of Dioxin Contaminated Materials at Love Canal

This OTA Staff Paper has neither been reviewed nor approved by the Technology Assessment Board.

J952-80

RESPONSE TO REQUEST FROM CONGRESSMAN LAFALCE FOR REVIEW OF DOCUMENTS ON THE CLEANUP OF DIOXIN CONTAMINATED MATERIALS AT LOVE CANAL

OTA agrees with the need to quickly remove the dioxin contaminated soils and sediments from the affected Love Canal areas, but we have serious reservations about the approach and methodology that were used to arrive at the recommended remedial action. From omissions in the documents supplied to us, it appears that an informal decision may have been made to select a remedial action that is not a permanent solution, but which could be of relatively low initial cost compared to a higher cost but permanent solution. (The cost comparisons, however, are highly uncertain, and an important design parameter of the impermanent remedy has yet to be fixed.) A decision based on cost alone is not consistent with the CERCLA statute, with EPA policies, or with the fact that there is a known responsible party against which an enforcement action is underway. For example, in its May 6, 1985 memo on off-site response actions EPA says: "When developing remedial alternatives, treatment, reuse or recycling must be considered. Such alternatives should not be screened out on the basis of cost alone." This statement implies but does not say explicitly that the final selection is also not be decided on the basis of cost alone.

The following discussion of the analysis elucidates some of the problems with the choice of the interim storage/land disposal option over a commercially available and proven permanent solution of thermal destruction.

PERMANENT VERSUS INTERIM REMEDY. The most disturbing feature of the Record of Decision and the CH2M-Hill report is that there is no statement of commitment or necessity to develop a permanent solution to follow interim storage. There is considerable ambiguity. In particular, the statement in the ROD that the chosen approach "is a cost-effective remedy and provides adequate protection of public health, welfare, and the environment" does not provide clear official

recognition that this remedial action is not a permanent solution. It would have been more correct to say "immediate remedy" and "adequate near-term protection."

One can question why the chosen interim storage action is being called a remedial action which is generally interpreted to signify a final cleanup action under the Superfund program. At other sites the term "initial remedial action" has been used. Why were the actions determined by a Record of Decision procedure rather than some other route such as immediate removals for the several specific locations which can be, as at other sites, called operable units?

INCOMPLETE COMPARISON. The comparison made is between impermanent, interim storage actions and permanent remedies. However, as discussed below, comparisons between impermanent and permanent remedies must consider the long term consequences and costs of impermanence; this the documents do not do. The May 6 memo of EPA says: "Detailed analysis of these alternatives should include consideration of long-term effectiveness of treatment and comparative long and short term costs of treatment as compared to other remedial alternatives."

With regard to technical effectiveness, interim storage does not offer the same level of environmental protection over the long-term as does a permanent solution based on the thermal destruction of the contaminated materials. There is no consideration in Chapter 7, the impact assessment of alternatives, of the long-term negative impacts of the interim onsite storage option, such as possible failures over time, potential corrective actions, or problems associated with ongoing environmental monitoring. It is not possible to even speculate as to the level of such impacts without knowing the length of time during which the interim storage would be used; the documents do not refer to

this crucial point, although there are hints that interim storage might be in effect for as long as 20 years. If so, the negative impacts ought not to be dismissed without consideration.

With regard to cost and cost-effectiveness, it is misleading to compare the costs of two fundamentally different approaches, each with different technical effectiveness. In this case, the costs for the eventual permanent solution that will follow the interim storage option were not even estimated. This omission makes the comparison invalid, unless one is willing to agree that the level of environmental protection can be arbitrary. In this case, if the level of protection is that afforded by interim storage, then the lowest cost remedy is interim storage. On the other hand, if the level of protection is that given by thermal destruction, then the lowest cost remedy is not interim storage.

UNCERTAIN COSTS. Moreover, the costs cited for the interim storage option are admitted to be highly uncertain; they are likely to be substantially underestimated because, for example, monitoring costs are apparently omitted. It is frustrating to try to figure out from the ROD and the CH2M-Hill report what the total estimated cost is for the interim storage solution. No total figure is ever given but it appears to be between $8 and $10 million. Another uncertainty arises because the important decision between using a berm facility or a concrete vault for storage is not made; it is deferred to the next, design step of the cleanup process. This is highly unusual and opens the door to cost increases after the fundamental decision between interim and permanent remedies has been made, partly on cost considerations. Furthermore, the design phase is supposed to implement the recommendation of the ROD, not make such a major decision without, for example, public comment. The costs for thermal treatment appear to be more certain because they are said to be based on estimates

prepared by commercial parties presumably prepared to bid on the work. However, in the case of the Huber technology, as discussed below, OTA has been informed by Huber that they did not provide CH2M-Hill with the data presented; but the difference between the cost data in the report and that provided to OTA is small. Huber's communication to OTA indicates a total cost of $1,000 to $1,100 per cubic yard at a level of 135,000 cubic yards rather than the broader range of $820 to $1,100 per cubic yard reported by CH2M-Hill for the Huber technology.

PERMANENT REMEDY IS AVAILABLE. Various statements in the ROD concerning alternatives to the interim storage option are incorrect with regard to what OTA finds is currently the general state of thermal treatment technology for toxic waste and particularly the best, proven alternative to the interim storage option. However, it should be noted that the differences among the thermal treatment options are less than the difference between interim land disposal and permanent treatment.

The most promising, proven thermal technology for this application is the use of the mobile, onsite Huber Advanced Electric Reactor. This technology is incorrectly called incineration in the report; it is instead a form of pyrolytic thermal destruction with advantages over conventional incineration (i.e., although any incineration technology might easily destroy dioxin on soil, the newer forms of thermal destruction are likely to do the job with only very small amounts, if any, of toxic air emissions and they may also offer greater operational reliability). (A one page description of this technology, taken from our recent report SUPERFUND STRATEGY is attached.) For example, the following statements are made to justify not using a thermal treatment approach:

"Various on-site and off-site disposal options exist which involve new (unproven) technologies." (CH2M-Hill report, p. 14)

"Incineration was also considered but did not seem to be a viable alternative for the immediate future. ....The wastes will be stored until such time as one of the above means of disposal/destruction becomes available or until another method becomes technically feasible." (p. 18)

"DEC officials expressed the belief that commercially available technology to dispose of dioxin contaminated sediments was 10 to 15 years away." (responsiveness summary, p.29)

These statements are incorrect. The Huber technology is commercially available and is so stated by EPA (statement of Dr. David G. Stephan, EPA ORD official, before the Subcommittee on Investigations and Oversight, Committee on Science and Technology, April 23, 1985; also EPA's "Assessment of Incineration As A Treatment Method for Liquid Organic Hazardous Wastes," March, 1985 which states that Huber's technology offers effectiveness "far in excess" of the RCRA requirement and is commercial as of mid-summer, 1985). Moreover, Huber successfully demonstrated the effectiveness of its technology in Times Beach, Missouri on November 13, 1984 on dioxin contaminated soil. The positive results have been well documented and made public by Huber. This test also showed that delisting the resulting residue would be no problem (as the dioxin levels were well below one part per billion), contrary to statements in the CH2M-Hill report. Note also that the CH2M-Hill report said that Huber had indicated it could have a unit available by early 1986 (p. 6-86).

In addition, the current issue of the CH2M-Hill magazine has an article on a site cleanup for which one of the mobile incineration units (ENSCO-Pyrotech) rejected for Love Canal was chosen over onsite containment. Indeed, the article

says "Onsite containment requires extensive monitoring and cannot assure that contaminants will not move offsite." The contaminants at the Florida site were volatile organic compounds and herbicides which are probably not as toxic as the dioxin at Love Canal. It is not clear from the article whether contaminated soil was treated. A company employee is quoted as saying "...there's enough work here that it doesn't ever need to leave the state." There is no doubt about the commercial status of this option, although unlike the Huber technology it may not yet have been tested on dioxin contaminated soil.

Finally, it has just been reported (July 12, 1985, The New York Times) that in a field demonstration the EPA mobile incinerator, another option considered by CH2M-Hill, has also effectively destroyed dioxin in contaminated soil in Missouri. OTA does not yet have data on residual levels of dioxin in the soil or on dioxin in air emissions.

The CH2M-Hill report notes problems in obtaining a RCRA permit for a mobile incineration unit while saying that for the land based interim storage facility functional equivalency but no permit itself would be necessary. Indeed, it is OTA's understanding that under current EPA policy no RCRA permit would be required for either onsite approach. Moreover, a different, recent report by CH2M-Hill notes the following: "EPA does not require permits for onsite fund-financed or enforcement actions taken under CERCLA." (CH2M-Hill, "Operable Unit Feasibility Study, Thomas Solvent Company's Raymond Road Facility, Battle Creek Michigan," June, 1985.)

It is reasonable to suggest that either Huber's past demonstrations or a simple test on the material at Love Canal would suffice to show that the technology was performing equivalently to a level required for a RCRA permit, without going through the lengthy and costly process of permitting.

All the cost estimates given by CH2M-Hill for thermal treatment include $400 per cubic yard cost for residue disposal. This is a high cost. If it were shown that the residue contained no significant amount of dioxin or other harmful substances, as has been done with the Huber technology and which might easily be done for any of the thermal treatment options, then the residue might be disposed of at a much lower cost, perhaps only $100 per cubic yard. If the latter were the cost, then all the cost estimates for thermal treatment are too high by $40 million at the 135,000 cubic yards level. This cost difference is particularly important for the case presented by CH2M-Hill of constructing a conventional, stationary onsite incinerator; the total adjusted cost for 135,000 cubic yards would be $60 million. According to CH2M-Hill's information, such a facility might be built in as little as 2 years and it would only take 16 months to treat that amount of soil because such a unit would be about seven times larger than the Huber mobile unit. Thus, the onsite, stationary incineration option might be the most cost-effective and timely alternative to the interim storage option and to the use of a mobile incinerator. Indeed, this approach is being pursued for other Superfund sites with large amounts of incinerable materials. However, there is little detail as to what type of incineration facility the cost estimates by CH2M-Hill are for, but presumably it is for a conventional type of incineration facility which poses some uncertainty for toxic air emissions and perhaps needs to be shown effective for dioxin contaminated soil.

PREFERRED INTERIM MEASURE. Because there is no constraint on the length of time during which the interim storage solution is to be in effect and because of the large amount of contaminated material to be stored, the concrete vault would probably be the preferred option. A berm facility would be more susceptible to

deterioration and failure over time and, as noted in the report, its size would preclude placement on site if the maximum amount of material anticipated is stored. Although the term land disposal is not used, the berm approach is essentially a form of landfilling with all the attendant likelihood of failure over time. DEC comments suggest that a period of from 10 to 15 years or more is being thought of. But since there is no plan or commitment made with regard to testing and evaluating permanent cleanup technologies for the site, the time might be longer. It should be noted however that in a real sense the use of the planned concrete vault for storage of hazardous material is unproven as it has not yet been used. In Missouri, such a plan was halted after considerable public debate about its high cost, its potential long term use, and the need to more aggressively pursue permanent cleanup technologies. A lower cost storage approach based on a simpler storage facility for containerized soil has been developed for Missouri, and it is not clear whether this approach has been considered for Love Canal. In Missouri there is also a definite program of evaluting new cleanup technologies that included the demonstration of the Huber technology. CH2M-Hill also worked on the Missouri dioxin cleanup.

UNRESOLVED ISSUES AND UNCERTAIN POLICIES. Questions can and undoubtedly will be raised about the obligation of the Federal Superfund program or a responsible party to fund a second stage permanent remedy. There is no explicit program planned, for example, involving the evaluation of permanent cleanup technologies by testing dioxin contaminated materials from Love Canal. There is no indication of what cost would be acceptable for a permanent solution, nor is there analysis to support that waiting will lead to lower rather than higher costs for a permanent solution. To the contrary, now is the time when companies are so eager to have an opportunity to show their technology effective for

Superfund cleanups that they may be more willing to cut profit margins or even, perhaps, to use a "loss leader" approach to capture an initial sale.

The ROD makes the case that the interim storage remedy is consistent with the fund balancing requirements of the statute; but it is not clear what cost of permanent remedy would be inconsistent with fund balancing. There is no indication of what steps EPA will take or is taking to evaluate and choose a permanent remedy, perhaps one that would reduce costs over thermal destruction. It is not clear whether there is any linkage to the Missouri efforts to permanently deal with a similar dioxin problem. It is unclear what priority the site will have for a permanent remedy, compared to other NPL sites, after the interim storage option is implemented.

OTA wants to clarify an important difference between the proposed remedial action of interim storage with the two-part strategy discussed in its SUPERFUND STRATEGY report. In the latter, an initial temporary action, such as storage, is deemed appropriate and cost-effective when no permanent solution is available. Moreover, such an initial action would have been taken much sooner and it would not be characterized as a remedial action. It would unambiguously be called a temporary action with a stated limit to its use and with a definite commitment for determining and implementing a permanent solution. If EPA wants to make a case for not using an available permanent solution known to be technically effective for the specific cleanup at Love Canal because its cost is judged to be too high with regard to fund balancing or because its use would result in unacceptable delays, then it ought to do so. However, neither the ROD or the contractor study makes this case, but instead maintains that no such permanent solution is now available and leaves open-ended and ambiguous the eventual use of a permanent remedy.

Some insight into EPA's policies is given by the following recent statement of a senior EPA official on cost-recovery under Superfund: "The key elements of this issue are whether responsible parties should be held liable for the potentially higher costs associated with developing and utilizing alternative and innovative technologies at Superfund sites, and whether it is appropriate to finance these additional costs with Superfund money." (Statement of Donald J. Ehreth, Deputy Assistant Administrator ORD, before the Subcommittee on Agricultural Resources and the Environment, Committe on Science and Technology, June 26, 1985)

It appears that EPA and DEC may be concerned with the impact of the cost of the chosen cleanup remedy on the ongoing cost-recovery enforcement effort. A permanent remedy that might cost over $100 million may be viewed as an impediment to a settlement with the responsible party in comparison to the $10 million interim storage remedy. Moreover, some settlements between EPA and responsible parties remove all their future liabilities. But who, then, ultimately, will pay for a permanent remedy?

ments, neutralization or scrubbing requirements, and catalyst loss. [Knoxville, TN: (615)690-3211]

9. J.M. Huber Corp., Advanced Electric Reactor.—The Advanced Electric Reactor (AER) rapidly heats materials to temperatures in the range of 4,000° F (2,200° C) using intense thermal radiation in the near infrared region. The reactants are isolated from the reactor core walls by means of a gaseous blanket formed by flowing nitrogen radially inward through the porous core walls (thus, its common name of "fluid wall reactor"). Solid waste is introduced at the top of the reactor through a metered screw feeder, and nitrogen is forced through the walls of the reactor.

After leaving the reactor, where pyrolysis occurs at temperatures of about 4,000° F, the product gas and waste solids pass through two post-reactor treatment zones. The first is an insulated vessel to provide additional high temperature (in excess of 2,000° F) and residence time (5 to 10 seconds). The second is water cooled to reduce the gas temperature to less than 1,000° F prior to downstream particulate cleanup. Solids exiting these zones are collected in a sealed bin. Additional solids in the product gas are removed by a cyclone and routed back to the solids bin. The product gas then enters a bag house for fine particulate removal followed by an aqueous caustic scrubber for chlorine removal. Any residual organics and chlorine are removed by passing the product gas through activated carbon beds just upstream of the emission stack. The organic, particulate, and chlorine-free product gas composed almost entirely of nitrogen is then emitted to the atmosphere through the process stack.

The AER runs entirely on electrical power and requires 800 to 1,200 kWh per ton for treating contaminated soils and 1,500 to 2,000 kWh per ton for the complete dissociation of liquids. Gaseous, liquid, or solid wastes can be treated. Pre-treatment of solids and liquids may be required to ensure that feed particle size is small enough for the reaction to proceed to completion within the residence time. The system is suited for the treatment of low Btu content hazardous materials (i.e., contaminated soils, pure PCBs, and other heavily halogenated hydrocarbons) and extremely hazardous materials (e.g., dioxins and nerve gases).

The principal products of soil-borne PCB destruction using the Huber process are H_2, Cl_2, HCl, elemental carbon, and a granular, free-flowing, solid material. Typical products of incineration, such as carbon monoxide, carbon dioxide, and oxides of nitrogen, are not formed in significant concentrations.

Huber has built and maintains two fully equipped reactors as part of its over $6 million RD&D program. The smaller reactor unit (0.6 pounds per minute of contaminated soil feed capacity) is installed in a covered truck trailer for mobility. It is used for proof-of-concept experiments and onsite demonstrations. The larger, pilot/commercial-scale reactor with a capacity of up to 50 pounds per minute or 10,000 tons per hour is used solely for research purposes. Although the larger unit has been permitted by EPA Region VI to commercially treat PCB-contaminated soils, corporate policy restricts its use to RD&D.

To date, four test programs have been conducted to demonstrate the effectiveness of the AER for treating soils contaminated with hazardous wastes. Tests were conducted in September 1983 on PCBs and certification was received from EPA Region VI in May 1984 under TSCA. A second series of tests were conducted in May 1984 with carbon tetrachloride in applying for a broad RCRA permit (expected in 1985). In October 1984, a test series was initiated on soils spiked with octachlorodibenzo-p-dioxin (a thermodynamically more stable surrogate for the acutely toxic 2,3,7,8 tetrachlorodibenzo-p-dioxin isomer). In November 1984, at Times Beach, Missouri, the mobile reactor was tested on soil contaminated with 2,3,7,8 TCDD and other dioxins.

Results from various test programs have provided typical gas phase DREs of 99.9999+ percent. In all cases, DREs were at least 99.9999 percent. Treated soil concentrations have always been equal or less than 1 ppb of the contaminant in question (PCB, CCl_4, dioxin) and usually nondetectable. Further, no chlorinated products of incomplete pyrolysis have been observed.

Operating costs depend on the size of the waste site and the soil pre-treatment requirements, which could include drying and sizing. For a large site (containing more than 10,000 tons of materials), the cost is estimated to be between $300 and $600 per ton. But costs could be as high as $1,000 per ton. Capital costs to build a large reactor are estimated at $10 million. [Borger, TX: (806)274-6331]

10. Thagard Research, High Temperature Fluid Wall Reactor.—This High Temperature Fluid Wall (HTFW) process is based on the same principles as the Huber's AER. The reactor was orginally developed for the continuous dissociation of methane into carbon fines and hydrogen. To accomplish this, temperatures in excess of 1,700° C (3,092° F) and a mecha-

STATEMENT OF

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CINCINNATI, OHIO
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

BEFORE THE

SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
COMMITTEE ON SCIENCE AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

APRIL 23, 1985

I am David G. Stephan, Director of EPA's Hazardous Waste Engineering Research Laboratory in Cincinnati, Ohio. I appreciate your invitation to discuss the Office of Research and Development's (ORD) engineering studies related to alternative technologies for destroying, detoxifying and containing hazardous wastes. We believe that ORD's activities, along with those of other organizations, are contributing significantly to advancing the state of the art for hazardous waste treatment and destruction technology.

I would like to highlight for you our program in three areas: containment technologies, in-situ treatment technologies (that is, techniques for decontaminating soils in place in the ground), and on-site clean-up equipment including physical, chemical, biological and thermal processes which can be applied to excavated soils. We are supporting research, development and evaluation projects on innovative techniques in each of these areas. I should point out that there will not be one universal solution to site clean-up problems. The range of site conditions and types of hazardous materials present is very broad. Our goal is to provide cost and performance information on a variety of alternatives so that reliable and cost-effective techniques can be chosen for various individual sites.

TABLE 1 (continued)

Process Name	Description	Waste Streams	State of Development	Test Data Available	Cost Data Available	For Information Contact
IGT "Cyclin" Cyclone Incinerator	A cylindrical shaped combustion chamber provides for intensive mixing of fuel and air	Gases or atomized liquids	C	C	1	Institute of Gas Technology 3424 South State Street Chicago, IL 60616 (312) 567-3650
Thagard High Temperature Fluid Wall Reactor	Uses electrically induced radiant heat to pyrolyze organic contaminants	Granular solids	C	A	2	Thagard Research Corporation 3303 Harbor Boulevard Suite F-4 Costa Mesa, CA 92626
Huber Advanced Elecrric Reactor	Uses electrical heat to pyrolyze organic materials at extremely high temperatures	Finely ground solids	C	A	1	J. M. Huber Corporation P. O. Box 2831 Borger, TX 79007 (806) 274-6331
Pyrolysis Systems Pyroplasma	Uses plasma arc device to create extremely high temperatures for waste destruction	Highly toxic liquids	P	C	2	Pyrolysis Systems, Inc 4935 Kent Street Niagara Falls, Ontario L2H 1J6 Contact: Mr. Ian Thom
Applied Energetics Plasma Temperature Incinerator	Burns waste in a pressurized stream of preheated oxygen	Liquids and fluidized solid waste	P	C	2	Applied Energetics, Inc. P. O. Box 1177 Tullahoma, TN 37388 (615) 455-0631 Contact: Dr. John B. Dicks

Legend for Table 1

State of Development
- C - Commercially available
- C* - Commercially available for other than hazardous wastes
- P - Pilot scale
- B - Lab and bench scale
- Co - Conceptual

Test Data Available
- A - Sponsored by EPA or other third party
- B - Company sponsored tests
- C - Company sponsored pilot scale tests
- D - Company sponsored bench scale tests
- NA - Not Available

Cost Data Available
- 1 - Based on commercial scale operation
- 2 - Estimates based on pilot scale operation
- 3 - Estimates based on bench scale operation
- NA - Not Available

United States
Environmental Protection
Agency

Office of Policy,
Planning and Evaluation
Washington, DC 20460

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Policy Planning and Evaluation

EPA

Assessment of Incineration As A Treatment Method for Liquid Organic Hazardous Wastes

Summary and Conclusions

CHART B

EMERGING ALTERNATIVE TECHNOLOGIES (continued)

Technology and Description	Suitable Wastes	Capacity Per Unit of Time	Cost Per Unit of Waste	Environmental Data	Commercial Status
HIGH TEMPERATURE ELECTRIC REACTOR: - two companies: Thagard Reaseach Huber Corporation - vertical reactor heated by electrodes implanted in the walls to pyrolize organic wastes	process initially designed for solid waste also suitable for liquid refractory waste streams	75 - 125 lbs of solids per hour no figures available for liquids, but it is assumed throughput would be less	cost information not avilable Huber claims cost comparable to conventional incineration	DREs far in excess of the 99.99% RCRA requirement	mid-summer 1985
MOLTEN SALT REACTOR: - burning and scrubing (900°C) oxidize carbons of organic matter to carbon dioxide and water - byproducts (phosphorous, arsenic, sulfer, halogens) retained in melt as inorganic salt	designed for solid and liquid waste especially applicable to highly toxic and halogenated combustible waste with low percentage of ash	pilot scale facility processes 80 to 200 lbs per hour	cost data not available	no emissions organic salts are the only biproduct DREs for organics, pesticides & chemical warfare agents 99.99% to 99.99999%	currently available for commercial use but none operating on that scale to date
PLASMA ARC: - uses the high temperature of plasma (50,000F) to destroy hazardous waste - all hardware in 45 foot mobile trailer	highly toxic liquid waste streams degree of halogenation not a consideration	600 lbs. per hour in commercially sized unit	cost data not available	current demonstration in New York state will provide info on DREs and emissions	commercial scale unit to be operating in 1 to 3 years

REPORTS

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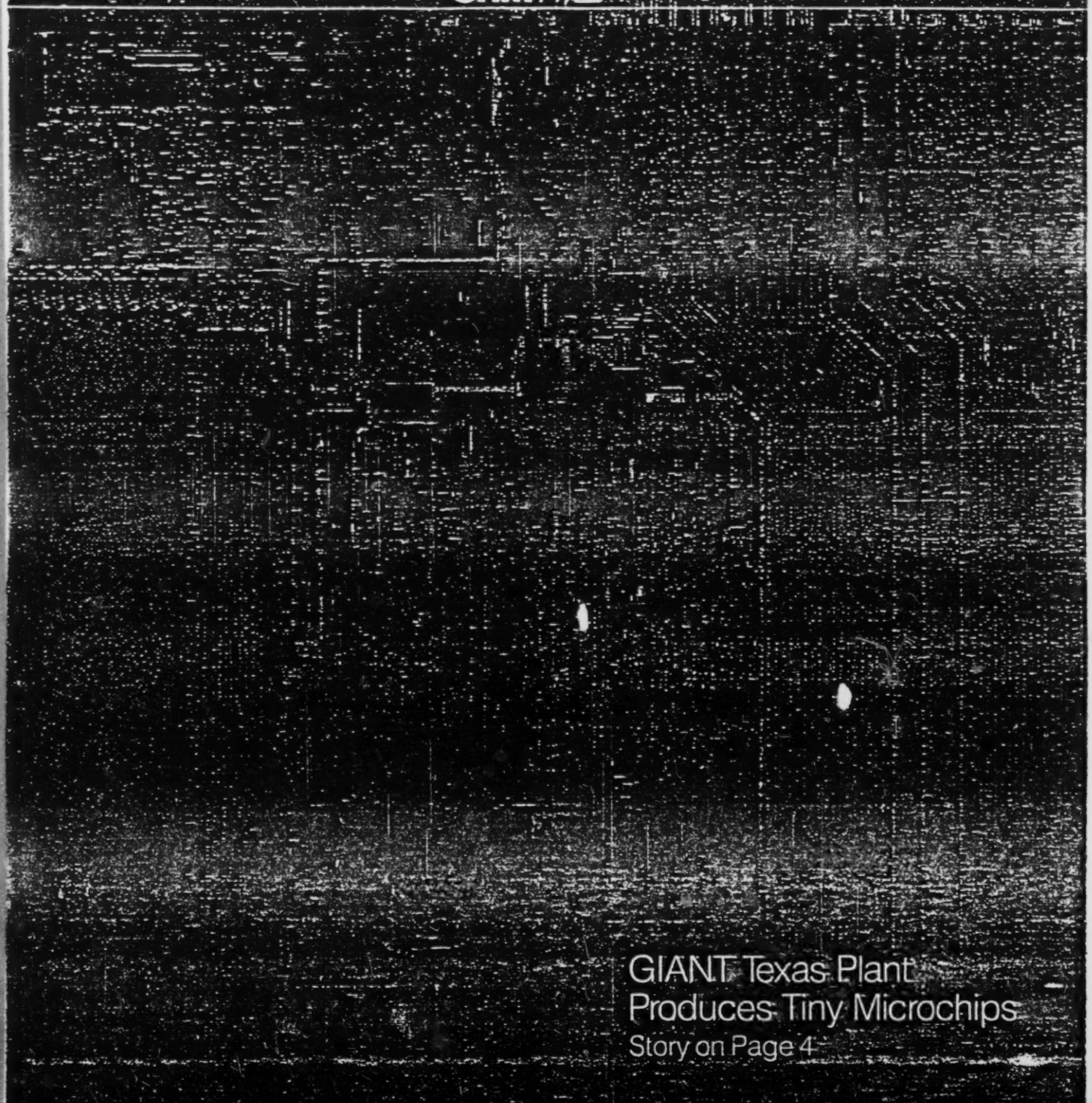

GIANT Texas Plant Produces Tiny Microchips

Story on Page 4

"After water quality is analyzed, the treated water is sprayed on land adjacent to the mine site. This clean water percolates down into the perched water table, flushing contaminated water toward the recovery wells," said Hatch. This also serves to clean up any contamination there may be outside the containment wall.

To complete cleanup of the Sydney Mine site, ash left from the incineration process, which is free from contaminants, will be used as final cover material at a nearby county landfill. The waste ponds will be filled with clean soils and seeded with native vegetation to restore the site to its original condition. ■

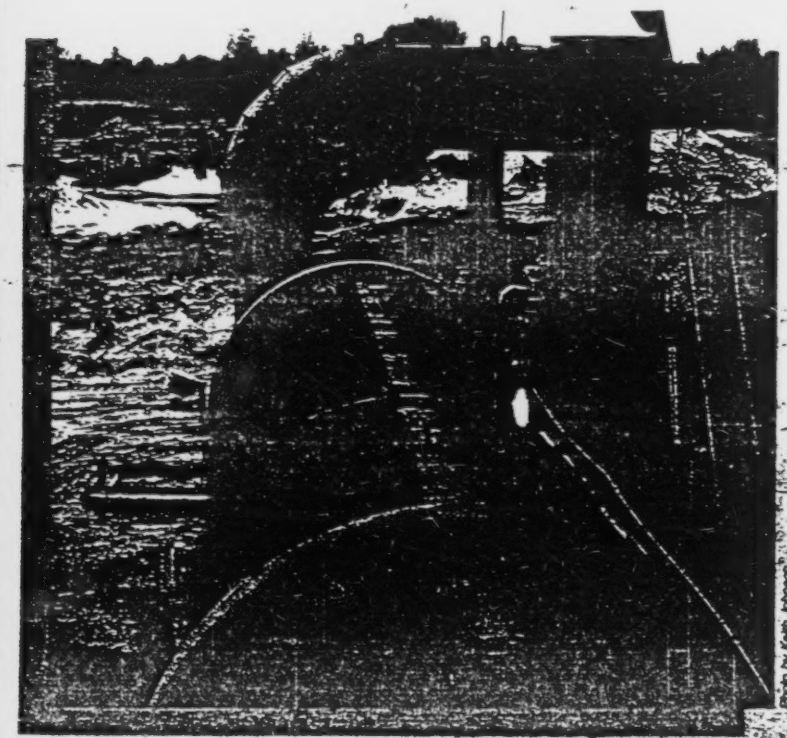

Photo by Keith Johnson

Contaminants contained in liquids, sludges and saturated tailing sands are burned or released when heated to 1,500° F in a rotary kiln.

MOBILE INCINERATION

When ENSCO-Pyrotech's seven-unit mobile incinerator rolled onto the Sydney Mine site in Florida, it was the first time for the company's incinerator to take on a job in the Sunshine state.

"It took some time for the incinerator to be permitted in Florida," said Cal Brunner, CH2M HILL incineration specialist. "And, now that it's been permitted, there's enough work here that it doesn't ever need to leave the state."

For clean-up at Sydney Mine, the incineration process is better than transporting waste to an offsite dump, according to Brunner. "Increasing the distance waste materials must be transported can increase risk. By bringing a mobile incinerator to the site, that risk is eliminated."

Incineration at the Sydney Mine site is a four step process.

1) Raw wastes are fed into a rotary kiln and heated to 1,500° F. At this high heat contaminants contained in liquids, sludges and saturated tailing sands are either burned or released.

2) During the burning process, hot gas is collected and cycled through an afterburner. Here, at temperatures exceeding 2,200° F, remaining contaminants are burned off.

3) Following reburning, the residual gas is forced into a steam generating boiler and run through a water bath. The steam-laden gas that remains passes through a scrubber where particulates (soot) are removed.

4) In the final step, gas flows through a demister — a mechanism designed to remove excess water, along with any remaining particulates. The cleaned gas is then released through a stack into the air. Any remaining inert ash can be used as final cover material in Hillsborough County's landfill. ■